CLAIMS

1. A method of manufacturing a workpiece, comprising the following steps:

placing respective layers of metal on the surfaces of both sides of a plate of ceramic material, the surfaces being generally mutually parallel;

cutting the metallized ceramic plate along parallel planes perpendicular to the metal layers to form a multiplicity of bars with respective sections of the cut metal layers disposed on opposite sides of each bar;

stacking the bars with metal layer facing metal layer, each pair of contacting metal layers forming a respective electrode;

bonding the stacked bars to form a stack with metal edges of the electrodes exposed on the periphery of the stack;

placing a first layer of dielectric material on a first face of the stack; and

placing a second layer of dielectric material on a second face of the stack;

wherein each of the first and second dielectric layers comprises a respective substrate that supports a respective pattern of metal applied before placement of the dielectric layers on the respective faces of the stack, metal-filled or metal–coated vias being formed in the first dielectric layer for electrically connecting the metal patterns on the first dielectric layer to respective odd-numbered electrodes and in the second dielectric layer for electrically connecting the metal patterns on the second dielectric layer to respective even-numbered electrodes.

2. The method as recited in claim 1, further comprising the step of grinding the first and second faces of the bonded stack flat, leaving the metal

edges of the electrodes exposed, before placing the layers of dielectric material.

3. The method as recited in claim 1, further comprising the following steps:

recessing the edges of at least some of the odd-numbered electrodes from the one face of the bonded stack and filling the recesses with electrically isolating material; and

recessing the edges of at least some of the even-numbered electrodes from the other face of the bonded stack and filling the recesses with electrically isolating material,

wherein said recessing steps are performed before placing the first and second dielectric layers.

4. The method as recited in claim 1, further comprising the step of placing a layer of electrically insulating spacer material on the first dielectric layer.

5. The method as recited in claim 4, further comprising the step of grinding the layer of spacer material to a desired thickness.

6. The method as recited in claim 4, further comprising the following steps:

cutting the bonded stack along parallel planes parallel to the electrodes to form a multiplicity of individual stacks, each stack comprising at least two odd-numbered electrodes and at least two even-numbered electrodes;

placing the individual stacks side by side with the respective electrodes being substantially co-planer and with the layers of spacer material

being mutually parallel and disposed on the same side of each individual stack; and

bonding the individual stacks to form a side-by-side array.

7. The method as recited in claim 6, further comprising the step of grinding the opposing faces of the array to expose metal of the odd-numbered electrodes closest to one face and the even-numbered electrodes closest to the other face.

8. The method as recited in claim 7, further comprising the step of bonding the side-by-side array to an acoustic backing layer comprising a body of acoustically attenuative material.

9. The method as recited in claim 8, further comprising the step of embedding a patterned array of electrical signal connectors in the body of acoustically attenuative material with respective ends of the electrical signal connectors exposed at a surface of the body.

10. The method as recited in claim 8, further comprising the step of cutting the side-by-side array along parallel planes perpendicular to a longitudinal axis of the individual stacks to a depth in the acoustic backing layer.

11. The method as recited in claim 8, further comprising the step of removing a substantial portion of the spacer material.

12. A method of manufacturing a workpiece, comprising the following steps:

placing respective layers of metal on the surfaces of both sides of a plate of ceramic material, the surfaces being generally mutually parallel;

cutting the metallized ceramic plate along parallel planes perpendicular to the metal layers to form a multiplicity of bars with respective sections of the cut metal layers disposed on opposite sides of each bar;

stacking the bars with metal layer facing metal layer, each pair of contacting metal layers forming a respective electrode;

bonding the stacked bars to form a bonded stack with metal edges of the electrodes exposed on the periphery of the bonded stack;

placing a first layer of dielectric material on one face of the bonded stack;

placing a second layer of dielectric material on another face of the bonded stack;

forming openings in the first dielectric layer to expose portions of respective edges of the odd-numbered electrodes;

forming openings in the second dielectric layer to expose portions of respective edges of the even-numbered electrodes;

filling or coating the openings with metal; and

placing respective layers of metal on the surfaces of the first and second dielectric layers in respective patterns, the respective patterned metal layers of the first and second dielectric layers being electrically connected to respective sets of odd- and even-numbered electrodes via the metal-filled or metal-coated openings.

13. The method as recited in claim 12, further comprising the step of grinding the first and second faces of the bonded stack flat, leaving the metal edges of the electrodes exposed, before placing the layers of dielectric material.

14. The method as recited in claim 12, further comprising the following steps:

recessing the edges of at least some of the odd-numbered electrodes from the one face of the bonded stack and filling the recesses with electrically isolating material; and

recessing the edges of at least some of the even-numbered electrodes from the other face of the bonded stack and filling the recesses with electrically isolating material,

wherein said recessing steps are performed before placing the first and second dielectric layers.

15. The method as recited in claim 12, further comprising the step of placing a layer of electrically insulating spacer material on the first dielectric layer.

16. The method as recited in claim 15, further comprising the step of grinding the layer of spacer material to a desired thickness.

17. The method as recited in claim 12, further comprising the following steps:

cutting the bonded stack along parallel planes parallel to the electrodes to form a multiplicity of individual stacks, each stack comprising at least two odd-numbered electrodes and at least two even-numbered electrodes;

placing the individual stacks side by side with the respective electrodes being substantially co-planer and with the layers of spacer material being mutually parallel and disposed on the same side of each individual stack; and

bonding the individual stacks to form a side-by-side array.

18. The method as recited in claim 17, further comprising the step of grinding the opposing faces of the array to expose metal of the odd-

numbered electrodes closest to one face and the even-numbered electrodes closest to the other face.

19. A method of manufacturing comprising the following steps:

placing respective layers of metal on the surfaces of both sides of each of a multiplicity of substantially identical plates of ceramic material, the metallized surfaces of each plate being generally mutually parallel;

laminating the metallized plates together with confronting metallized surfaces to form a block; and

cutting the block along parallel planes perpendicular to the metal layers to form a multiplicity of stacks, each stack comprising alternating ceramic layers and electrodes with metal edges of the electrodes exposed on the periphery of each stack.

20. The method as recited in claim 19, further comprising the following steps performed for at least one of the stacks:

placing a first layer of dielectric material on a first face of the stack; and

placing a second layer of dielectric material on a second face of the stack;

wherein each of the first and second dielectric layers comprises a respective substrate that supports a respective pattern of metal, vias being formed in the substrate of the first dielectric layer for electrically connecting the metal patterns on the first dielectric layer to respective odd-numbered electrodes and in the substrate of the second dielectric layer for electrically connecting the metal patterns on the second dielectric layer to respective even-numbered electrodes.

21. The method as recited in claim 20, further comprising the step, performed for at least one of the stacks, of grinding the first and second faces of the bonded stack flat, leaving the metal edges of the electrodes exposed, before placing the layers of dielectric material.

22. The method as recited in claim 21, further comprising the following steps performed for at least one of the stacks:

recessing the edges of at least some of the odd-numbered electrodes from the one face of the bonded stack and filling the recesses with electrically isolating material; and

recessing the edges of at least some of the even-numbered electrodes from the other face of the bonded stack and filling the recesses with electrically isolating material,

wherein said recessing steps are performed before placing the first and second dielectric layers.

23. An ultrasound transducer array precursor comprising:

a stack comprising a multiplicity of layers of ceramic material and a multiplicity of electrodes stacked in alternating sequence, said multiplicity of electrodes comprising odd-numbered electrodes and even-numbered electrodes arranged in alternating sequence, with a metal edge of each odd-numbered electrode being exposed on a first face of said stack and a metal edge of each even-numbered electrode being exposed on a second face of said stack;

a first layer of dielectric material joined to said first face of said stack;

a second layer of dielectric material joined to said second face of said stack;

a first metal pattern formed on or in said first dielectric layer;

a second metal pattern formed on or in said second dielectric layer;

a first set of metal-filled vias or channels formed in said first dielectric layer for electrically connecting said first metal pattern to said odd-numbered electrodes; and

a second set of metal-filled vias or channels formed in said second dielectric layer for electrically connecting said second metal pattern to said even-numbered electrodes.

24. The ultrasound transducer array precursor as recited in claim 23, further comprising a layer of electrically insulating spacer material applied on top of said first dielectric layer.

25. An ultrasound transducer array comprising a first row of laminated transducer elements that are acoustically isolated from each other, each of said laminated transducer elements comprising:

a stack comprising first, second and third layers of ceramic material of substantially equal thickness;

a first electrode disposed on the top of said first ceramic layer;

a second electrode disposed between said first and second ceramic layers;

a third electrode disposed between said second and third ceramic layers;

a fourth electrode disposed on the bottom of said third ceramic layer;

a first electrical connector disposed on one side of said stack and electrically connecting said first and third electrodes;

a second electrical connector disposed on the other side of said stack and electrically connecting said second and fourth electrodes;

a first layer of dielectric material disposed on said one side of said stack between said first electrical connector and an edge of said third electrode; and

a second layer of dielectric material disposed on said other side of said stack between said second electrical connector and an edge of said second electrode.

26. The array as recited in claim 25, further comprising a second row of laminated transducer elements that are acoustically isolated from each other and from said laminated transducer elements of said first row, said laminated transducer elements of said second row having substantially the same structure as that of said laminated transducer elements of said first row and being respectively aligned to form a multiplicity of columns.

27. The array as recited in claim 26, further comprising an acoustic backing layer made of acoustically attenuative material, said first and second rows of laminated transducer elements being acoustically coupled to said acoustic backing layer, and a patterned array of electrical signal connectors embedded in said acoustic backing layer with respective ends of the electrical signal connectors exposed at a surface that confronts said first and second rows of laminated transducer elements, said fourth electrodes being respectively in electrical contact with said electrical signal connectors.

28. The array as recited in claim 25, wherein said first electrical connector comprises metallization on said first dielectric layer and metal-filled vias or channels that pass through said first dielectric layer.